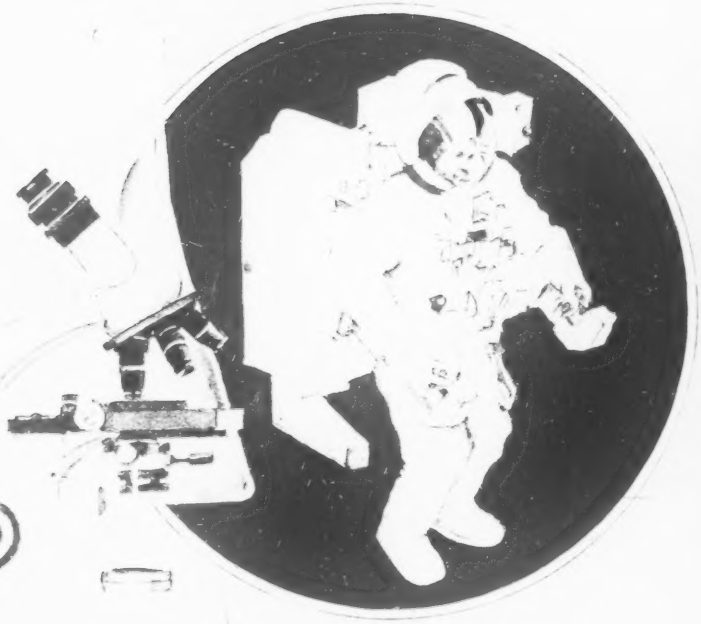
Chemical company earnings continue to slump
Page 18

NEWS



Federal R&D Budget '92

President gives special emphasis to basic research, but seeks more funds for all areas Page 7

Volume 69, Number 7
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CHEMICAL & ENGINEERING NEWS

FEBRUARY 18, 1991

News of the Week

■ **Department of Energy issues long-awaited "reconfiguration" plan for future of its nuclear arms complex, and Office of Technology Assessment issues extremely critical report on the problems of cleaning up the past sins of the complex.** Page 4

■ **FDA orders Monsanto to stop promoting genetically engineered bovine growth hormone while it is still under review.** Page 5

■ **U.S. leadership in biomedical research is slipping, according to Gallup poll that surveyed academic and industrial research leaders and NIH grantees.** Page 5

■ **Stanford research group develops superconducting superlattice that could provide easier route to sandwich-type tunnel junctions, among other potential applications.** Page 6

Business

Earnings of major chemical companies slumped in 1990 primarily because of higher feedstock costs, continued sag in the economy. **Page 18**

Government

Rising costs of pollution control may force EPA to change regulatory direction, leading to adoption of pollution prevention strategy. **Page 25**

Charles Benbrook, former executive director of NAS's Agriculture Board, remains upset over his discharge and the reasons behind it. **Page 27**

Science/Technology

Strategies for environmental management in the next decade and beyond were put forth by environment ministers of the 24 OECD nations meeting last month in Paris. **Page 32**

Biological mineralization—the process that forms bones, teeth, and shells—is mimicked in artificial system. **Page 33**

Hints to researchers on how to maintain electronic records for patent purposes offered in free ACS pamphlet. **Page 34**

Books

"Making Science Our Own" surveys writing about science in the U.S. 1910–55, and details how myths were perpetuated. **Page 35**

ACS News

Project to produce a sourcebook for aiding handicapped chemists is making strong progress. **Page 39**

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News Focus

Bush's proposed 1992 budget would give a healthy boost to basic and applied research programs with projects such as the Superconducting Super Collider and human genome research receiving hefty hikes. **Page 7**

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LETTERS

Chirality in pharmaceuticals

Seemon H. Pines' response (C&EN, Nov. 26, 1990, page 5) to Stu Borman's feature article on chirality (C&EN, July 9, 1990, page 9) clearly states that chemists are trained in the art of asymmetric synthesis and are capable of designing economically feasible routes to enantiomerically pure or enriched pharmaceuticals. To a great extent their task has been simplified by the commercial availability of chiral, enantiomerically pure building blocks.

Because of demand, industry has undertaken the challenge of developing commercial-scale processes that remove the stigma of "laboratory curiosity" from elegant asymmetric synthetic reactions. For example, the commercial availability of enantiomerically pure, chiral glycidols is not only a reflection of K. Barry Sharpless' novel epoxidation reaction, but a testament to the ability of process chemists and engineers who made multiton production possible.

With production at such a scale, the pharmaceutical industry can be assured of versatile, enantiomerically pure building blocks at reasonable costs. This will allow the growing trend toward enantiomerically pure or enriched chiral drugs to continue without the "extreme increases in production costs" forecast in Borman's article.

Harry Mazurek
Project Manager
Arco Chemical

A necessary adjective

We must of course accept Robert L. Wolke's claim to be a lifelong student of English (C&EN, Nov. 12, 1990, page 43). He should then be aware that the trouble he is trying to evade started a long time before the U.S. was born. The English word "chemical" has been used since the middle of the 16th century as an adjective with the connotation of belonging to, relating to, or having been obtained by chemistry; half a century or so later, in 1615, by extension it was used to describe people with the connotation of being versed in chemistry. Starting in the middle of the 18th century it has become used as a noun—usually in the plural—its original significance being in distinguishing those compounds made by chemists from those occurring naturally.

We (that is, we members of the American Compound Society, as I suppose we should now be called) nowadays do not make such a distinction, having more chemical knowledge, and perhaps more respect for the "unnatural." Popular opinion, once fashioned by education, now molded by "the media," has been forced to overreact to the cynical mistreatment of nature by the chemical industry over the past century and a half, but we need not compound (chemical?) this by overreacting in our turn and banning a useful shorthand noun, not to say a necessary adjective.

John R. Millar
Blagdon, England

Political environmentalism

The book review by Jim Sibbison (C&EN, Oct. 29, 1990, page 31) cannot remain unchallenged. As a charter member of the Environmental Protection Agency, I am proud of our accomplishments. At the same time, I am less than proud that many mistakes were made and numerous opportunities were lost.

When EPA was formed, all of us enthusiastically accepted the support of political advocacy groups. Most of us were dedicated to the protection of the environment, which was a declared goal of these advocacy groups. However, gradually it became clear that there were two distinct approaches for establishing environmental priorities, regulating environmental pollutants, and imposing controls. Whereas the scientific environmentalists chose to rely upon the best available scientific information, the political environmentalists relied upon political advocacy and ideology. The scientific environmentalists were essentially apolitical. Conversely, the political environmentalists wanted a scientific justification for their preconceived actions by choosing data that fitted their requirements and disregarding every other information. When confronted, they found many excuses for not relying upon best available scientific information. These excuses were expressed as lack of data, the need for prudence, and disagreement among scientists on

Letters to the Editor

C&EN encourages readers to contribute to this letters section. However, please keep letters reasonably short—400 words or fewer. Because we receive a heavy volume of letters, persons writing letters are limited, as a general rule, to one letter within any given six-month period.

Administration's 1992 Budget Proposes a Healthy Boost for R&D

Basic research would increase 8%, grabbing 18% of total R&D budget, and funds for applied R&D would jump 13%; Superconducting Super Collider and human genome research would get big hikes

David J. Hanson, Janice R. Long, and **Pamela S. Zurer,**
C&EN Washington

In submitting his second comprehensive federal budget proposal to Congress, President Bush repeated a major theme found in his first budget—the importance of research and development, particularly basic research, to the economic and social health of the nation. For fiscal 1992, he once again calls for increasing federal R&D spending by a much larger percentage than overall federal spending, which is up 4% to $1.44 trillion.

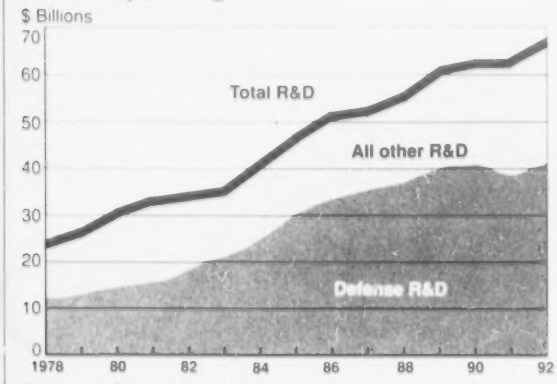
In the White House's fiscal 1992 budget proposal, obligations for the conduct of R&D would rise 12%, or $8 billion over current levels, to $72.1 billion. Within that total, obligations for defense R&D, conducted by both the departments of Defense and Energy, would increase 14% to $43.2 billion. Obligations for civilian R&D would be up 9% to $28.8 billion.

Obligations for basic research are slated to increase 8% to $13.3 billion, accounting for 18% of the federal R&D budget. Civilian basic research would rise 9% to $12.3 billion, and defense basic research would rise 2% to just over $1 billion. Overall obligations for applied R&D would increase 13% to $58.8 billion, with those for defense up 15% to $42.2 billion and those for civilian applied work up 10% to $16.6 billion.

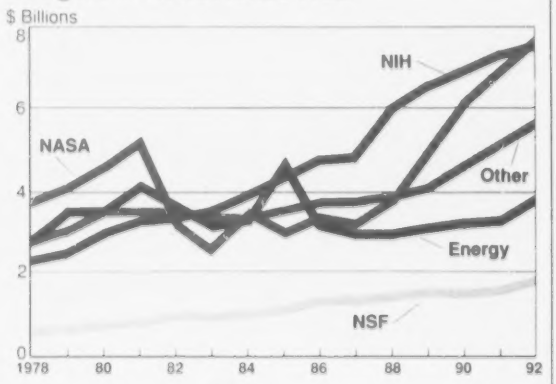
Highlights of the fiscal 1992 basic research budget, as selected by the Office of Management & Budget, include increases of:

- $406 million to $2.7 billion to put the National Science Foundation back on track to doubling its budget, this time by 1994.
- $334 million to $5 billion for increasing basic biomedical research at the National Institutes of Health.
- $291 million to $534 million for the Superconducting Super Collider.
- $52 million to $125 million for an expanded agricultural research initiative.

Defense accounts for 60% of R&D spending . . .



. . . while NIH, NASA account for largest budgets in nondefense R&D



Note: Outlays Source: Office of Management & Budget

• $35 million to $165 million for the human genome project.

In the applied R&D area, OMB singles out the $903 million, an increase of $227 million, set aside for energy R&D; $638 million, up $149 million, earmarked for high-performance computing and communications; and a $1.3 billion advanced manufacturing and materials program, whose funding actually declines by $6 million in fiscal 1992.

An additional $3.5 billion, 15% more than is being spent this year, is earmarked for construction, repair, and modernization of R&D facilities, bringing total proposed federal support for R&D to $75.6 billion, an increase of 13% over fiscal 1991 funding levels.

In the following sections, C&EN provides a closer look at the R&D budget proposed for the various federal agencies that support R&D activities, starting with the largest R&D funding source and descending to the smallest.

Defense Department. The past two years have seen the DOD research and development budget proposal take a beating from Congress, but the Administration is once again asking for a large increase. This year, basic and applied research would receive about $3.9 billion and development and testing more than $36 billion. This is a 15% increase for DOD over last year's figures, and it contrasts with the slower rate of growth (about 12%) proposed for civilian R&D programs.

The Administration says in fiscal 1992 DOD's basic research program will place new emphasis on high-performance computing and improved materials for electronics, gas-turbine engines, and airframe components. Initial estimates indicate individual investigators will be funded at about the same levels as they are in the current fiscal year since funding for DOD's basic research programs is not increasing so fast as inflation, which the Administration estimates will be running at a rate of 3.8% in fiscal 1992.

DOD's proposed R&D budget will also support such development projects as Sematech, the semiconductor industry consortium formed to advance the manufacture of semiconductor materials, and the nation-

TOTAL FEDERAL R&D BUDGET PROPOSAL

Outlays for R&D are up 7% . . .

$ Millions[a]	Obligations 1992 proposed	Obligations 1991 enacted	Obligations % change	Outlays 1992 proposed	Outlays 1991 enacted	Outlays % change
BY AGENCY						
Defense[a]	$40,479	$35,176	15%	$38,421	$36,142	8%
Health & Human Services	9,836	9,273	6	9,235	8,704	6
NASA	8,602	7,271	18	7,767	6,974	11
Energy	6,410	6,149	4	6,273	5,810	8
NSF	2,112	1,828	16	1,897	1,675	13
Agriculture	1,261	1,224	3	1,198	1,152	4
Interior	562	584	−4	567	572	−1
Commerce	538	517	4	499	454	10
EPA	491	433	13	450	418	8
Transportation	435	407	7	411	373	10
Agency for International Development	413	385	7	445	337	32
Veterans Affairs	219	219	0	219	215	2
Other agencies	720	645	12	664	611	12
BY FUNCTION						
Applied R&D	**58,758**	**51,791**	**13**	**55,650**	**51,840**	**7**
Defense[b]	42,206	36,760	15	40,147	37,794	6
Civilian	16,552	15,031	10	15,503	14,046	10
Basic research	**13,319**	**12,320**	**8**	**12,416**	**11,597**	**7**
Civilian	12,278	11,296	9	11,364	10,623	7
Defense[b]	1,041	1,024	2	1,052	974	8
TOTAL	**$72,078**	**$64,111**	**12%**	**$68,066**	**$63,437**	**7%**

. . . as are those for basic research . . .

$ Millions	Obligations 1992 proposed	Obligations 1991 enacted	Obligations % change	Outlays 1992 proposed	Outlays 1991 enacted	Outlays % change
Health & Human Services	$ 5,477	$ 5,101	7%	$ 5,097	$ 4,786	6%
(NIH)	(4,968)	(4,634)	7	(4,622)	(4,372)	(6)
NSF	1,987	1,719	16	1,784	1,560	14
NASA	1,960	1,698	15	1,800	1,612	12
Energy	1,759	1,726	2	1,654	1,650	0
Defense[b]	1,010	992	2	1,021	942	8
Agriculture	598	563	6	553	539	3
Other agencies	529	521	2	506	507	0
TOTAL	**$13,320**	**$12,320**	**8%**	**$12,415**	**$11,596**	**7%**

. . . but outlays for R&D facilities rise 15%

$ Millions	Obligations 1992 proposed	Obligations 1991 enacted	Obligations % change	Outlays 1992 proposed	Outlays 1991 enacted	Outlays % change
Energy	$1623	$1199	35%	$1442	$1161	24%
NASA	885	857	3	850	722	18
Defense[b]	538	461	17	482	463	4
NSF	153	111	38	124	155	−20
Agriculture	128	156	−18	122	148	−18
Health & Human Services	130	186	−30	153	111	38
Other agencies	88	113	−22	93	86	8
TOTAL	**$3545**	**$3083**	**15%**	**$3266**	**$2846**	**15%**

Note: All numbers are estimates. **a** Numbers exclude R&D facilities funding. **b** Includes military-related R&D programs of the departments of Defense and Energy. **Source:** Office of Management & Budget

al aerospace plane program, which is being run in conjunction with NASA.

The largest single item in the R&D proposal is funding for the Strategic Defense Initiative. Although cut back significantly last year by Congress, SDI funding is proposed at $4.6 billion for fiscal 1992, up from $2.9 billion this year. The SDI program has been refocused. Research is now aimed at protection from accidental or unauthorized ballistic missile launches.

Health & Human Services. The Administration has asked for about $10 billion in fiscal 1992 for research and training at HHS. The bulk of those funds are commanded by the National Institutes of Health, which would receive a 6% increase over 1991 to $8.8 billion. NIH is the largest single source of support for biomedical research in U.S. universities, including almost one third of academic chemistry research funding.

NIH has long enjoyed special treatment from Congress, which regularly appropriates more money for the prestigious institution than the President requests. For example, Congress awarded NIH $8.3 billion for fiscal 1991 although Bush asked for only $7.9 billion.

DOD seeks return to R&D increases

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
Engineering development	$11,135	$ 9,050	$11,025	23%
Advanced development	11,128	10,525	10,249	6
Operational systems development	10,830	8,442	9,238	28
Management & support	2,960	2,689	2,775	10
Exploratory development	2,860	2,724	2,408	5
Research	1,010	1,125	936	−10
TOTAL	$39,923	$34,555	$36,631	16%

Note: Obligations. a Estimate b Actual. **Source:** Department of Defense

But the word on the NIH grapevine is to expect the pattern of Congressional largess to be broken this year, given the unprecedented stresses on the federal budget. NIH officials are figuring that what the Administration has requested is all they will get for fiscal 1992.

After being inundated by complaints from the scientific community about the shortage of grants from NIH, last year both the House and the Senate Appropriations committees instructed NIH to take a hard look at managing costs. The committees suggested NIH gradually raise the number of new grants it awards each year to 6000 while simultaneously holding down cost increases. Many scientists and research administrators welcome the proposal to increase numbers of grants, but others are afraid a target of a specific number of grants could lead NIH to fund the cheapest rather than the best grants if the budget did not grow sufficiently.

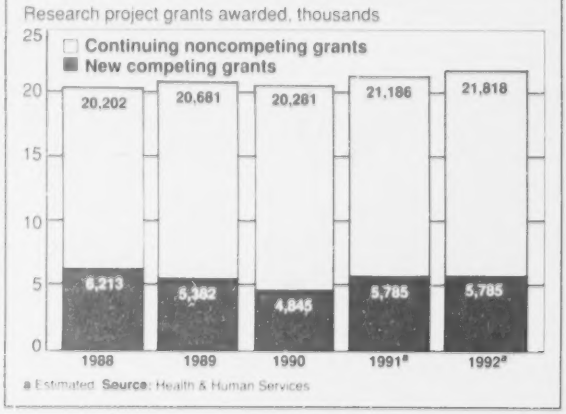
The current NIH budget request allows modest growth in the number of grants without cutting their size. Funds for research project grants awarded by NIH to outside research institutions would increase 9% to $4.9 billion in fiscal 1992. That would allow NIH to support 21,818 grants, about 600 more than in fiscal

NIH's human genome R&D again scores big

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
National Institutes	$7980.0	$7439.0	$6893.9	7%
Cancer	1810.2	1713.8	1643.4	6
(AIDS)	(169.0	159.8	149.3	6)
Heart, Lung & Blood	1209.9	1126.9	1070.7	7
(AIDS)	(45.7	43.4	42.1	5)
Allergy & Infectious Diseases	976.7	907.3	832.2	8
(AIDS)	(459.3	433.6	394.1	6)
General Medical Sciences	833.2	760.0	710.6	10
(AIDS)	(16.5	15.6	14.6	6)
Diabetes & Digestive & Kidney Diseases	658.6	615.3	580.2	7
Neurological Disorders & Stroke	583.4	541.7	489.3	8
(AIDS)	(17.6	16.5	16.2	7)
Child Health & Human Development	520.6	479.0	442.0	9
(AIDS)	(34.7	31.0	26.7	12)
Aging	348.6	323.8	238.9	8
Eye	272.3	253.2	236.5	8
Environmental Health Sciences	254.5	241.0	228.7	6
Arthritis & Musculoskeletal & Skin Diseases	204.8	193.2	168.6	6
Dental Research	160.9	148.9	135.5	8
Deafness & Other Communication Disorders	146.3	134.9	117.3	8
National Center for Human Genome Research	110.5	87.4	59.5	26
National Center for Research Resources[c]	321.0	335.3	337.1	−4
Other	363.5	415.0	285.9	−12
TOTAL	$8774.9	$8276.7	$7576.4	6%

Note: Obligations for AIDS research are included in totals for each institute. Subtotals for AIDS are broken out where they exceed $10 million. a Estimate. b Actual. c Previously known as Division of Research Resources. **Source:** National Institutes of Health

NIH budget would allow modest growth in total grants



a Estimated. **Source:** Health & Human Services

NASA focuses on space and Earth sciences

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
Space station	**$2022.5**	**$1894.5**	**$1714.9**	**7%**
Scientific investigations in space	**1932.6**	**1588.8**	**1365.1**	**22**
Physics & astronomy	1132.3	1000.0	873.1	13
Planetary exploration	618.8	455.3	385.8	36
Life sciences	181.5	133.5	106.2	36
Space applications (Earth sciences)	**976.6**	**929.3**	**641.9**	**5**
Space transportation capability development	**865.9**	**658.9**	**637.3**	**31**
Aeronautical research & technology	**587.2**	**511.5**	**449.3**	**15**
Space research & technology	**415.3**	**305.2**	**285.2**	**36**
Commercial programs	**146.8**	**89.9**	**58.3**	**63**
Transatmospheric vehicle	**73.2**	**92.4**	**59.1**	**–20**
Academic programs	**64.1**	**61.7**	**28.2**	**4**
Safety, reliability & quality assurance	**33.6**	**35.3**	**21.9**	**–5**
Tracking & data systems	**21.9**	**19.5**	**19.8**	**12**
TOTAL	**$7139.7**	**$6187.0**	**$5281.0**	**15%**

Note: Obligations. a Estimate. b Actual. **Source:** Office of Management & Budget

1991 and an all-time high. Of those, 5785 would be new grants, the same number projected for fiscal 1991. The request allows the average cost of both continuing and new grants to increase at the rate of inflation.

"We can be very pleased given the context of the overall budget constraints," says Marvin Cassman, deputy director of NIH's National Institute of General Medical Sciences. "There is a clear emphasis being given to research project grants. There is an expansion of the number of grants overall, without a squeeze on the size of the grants."

NIGMS, which is the source of most NIH funds that go to chemistry departments, would receive a 10% increase in fiscal 1992 to $833 million. That's a larger increase than any other NIH entity except for the high-profile Center for Human Genome Research. Bush has requested a 26% rise to $110 million for the center's project to map and sequence human chromosomes.

AIDS research, spread throughout most NIH units but concentrated in the Institute for Allergy & Infectious Disorders, would get a 6% increase to $851 million.

National Aeronautics & Space Administration. The budget proposes a 15% increase for R&D at NASA in fiscal 1992 to $7.1 billion. At $2 billion, the space station is still the largest single item in the NASA research budget. But that figure is only 7% higher than last year, far short of original projections. At Congress' request, the agency is in the process of redesigning the space station to simplify it and decrease its dependence on the space shuttle.

Scientific research in space, which NASA Administrator Richard H. Truly calls a "top priority," would receive a big boost in the proposed budget, up 22% to $1.9 billion. Included are astronomy, life sciences, planetary exploration, and materials sciences programs.

NASA's Mission to Planet Earth is slated to receive $773 million in fiscal 1992, a 19% increase over last year. Its single largest component is the Earth Observing System, a series of huge satellites that would monitor a large number of Earth processes simultaneously. Included in the $336 million the Bush Administration has requested for the observation system is more than $80 million for a management system designed to cope with the massive inflow of new data expected.

Another $400-plus million in the Earth mission budget would support a variety of research programs and smaller satellites. Among those is the Upper Atmosphere Research Satellite, set to be launched in November, which is designed to study ozone depletion. And $5 million has been requested for remotely piloted aircraft that could carry research instruments into the stratosphere for weeks at a time. The concept was proposed by Harvard University chemistry professor James G. Anderson as a way to gather data crucial to understanding ozone loss and climate change.

The funds for the Earth mission in NASA's budget make up almost two thirds of the $1.2 billion the Bush Administration has proposed for global-change research in fiscal 1982. The Committee on Earth & Environmental Sciences, under Presidential Science Adviser D. Allan Bromley's Office of Science & Technology Policy, is coordinating interdisciplinary research across nine federal agencies aimed at understanding and predicting global change such as ozone depletion, greenhouse warming, deforestation, and sea-level rise.

The Bush Administration's 1992 requested funds for global change research is a 24% increase over 1991 and almost double the funds appropriated in 1990. In addition to NASA, the National Science Foundation; the Commerce Department's National Oceanic & Atmo-

Climate research funds climb since 1990

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
NASA	**$ 772.6**	**$651.6**	**$488.6**	**19%**
Earth Observing System	336.0	191.0	74.0	76
Other Earth sciences programs	431.6	460.6	414.2	–6
Remotely piloted aircraft	5.0	—	—	—
NSF	**118.5**	**87.1**	**55.0**	**36**
NOAA[b]	**78.0**	**47.0**	**18.0**	**66**
Energy	**77.0**	**65.6**	**50.0**	**17**
Agriculture	**53.2**	**38.6**	**21.2**	**38**
Interior	**46.4**	**36.6**	**13.3**	**27**
EPA	**26.0**	**21.8**	**13.2**	**19**
Smithsonian	**7.5**	**5.4**	**—**	**39**
Defense	**6.3**	**—**	**—**	**—**
TOTAL	**$1185.5**	**$953.7**	**$659.3**	**24%**

a Estimate. b National Oceanic & Atmospheric Administration. **Source:** Office of Science & Technology Policy's Committee on Earth & Environmental Sciences

Glossary of budget terms

Fiscal year. Year running from Oct. 1 to Sept 30. The fiscal year is designated by the calendar year in which it ends.
Obligations. Commitments made by federal agencies to pay out money for products, services, or other purposes, as distinct from the actual payment.
Outlays. Payments for obligations incurred under Congressionally granted budget authority generally made by issuance of checks on the Treasury. Outlays during any fiscal year may be for obligations incurred in prior fiscal years or in the same fiscal year.

Note: The R&D numbers from individual agencies frequently differ from those used by the Office of Management & Budget in preparing its analysis of total federal R&D funding.

spheric Administration; the departments of Energy, Agriculture, and Interior; and the Environmental Protection Agency would also receive significant funding for the program. The Smithsonian Institution and the Department of Defense are minor players.

Department of Energy. DOE's fiscal 1992 R&D budget proposal is built around the forthcoming National Energy Strategy, according to Energy Secretary James D. Watkins, and includes $653 million for DOE strategy-related R&D, an increase of $134 million, or 26%, for fiscal 1992. Over the five-year period 1992 through 1996, DOE will invest $3.5 billion in these initiatives.

This new energy R&D strategy is intended to foster a new, results-oriented approach, and not merely more of the same traditional government-funded energy R&D programs. It aims to avoid the mistakes of the past. As the budget documents point out, from 1980 through 1990 the government invested about $21 billion in energy technology R&D. But that investment has had relatively little payoff for a number of reasons. These include the inherently high risk of some R&D; poor R&D choices, such as synthetic fuels and breeder reactors; and lack of significant private-sector financial and management involvement linking R&D to successful commercial deployment.

Among the increases linked to the energy strategy are $69 million, to $314 million, for advanced electricity technology, including $178 million for advanced reactor concepts, $51 million for photovoltaics, and $22 million for superconductivity research. Research on new transportation fuels gets a $24 million increase to $113 million, including $52 million for research on advanced oil recovery, $44 million for fuels from biomass, and $17 million for alternative fuel utilization research.

On paper DOE's research on basic energy sciences is not sharing any of this budget largess; its budget is essentially frozen at $570 million. Funding for basic energy sciences' chemical program appears almost flat at $158 million, while that for materials science is apparently down 7% to $257 million.

However, all is not as it appears. Hidden in the basic energy sciences fiscal 1991 budget is $59.2 million for Congressionally directed projects for which DOE has no intention of seeking more funds. A good portion of that project money, $46.8 million, is included in the division of materials sciences fiscal 1991 budget. When factored out, the division's core programs show an increase of 12% for fiscal 1992. Research funded out of materials sciences would increase 4% to $157 million, while funds for facilities operations would rise 29% to $100 million.

DOE's division of chemical sciences has no Congressionally mandated projects hidden within its fiscal 1991 budget, neither does it have any major increase for 1992. In fact, according to DOE budget documents, the chemical sciences research budget would drop 2% to $98 million, but its facilities operation budget would rise 4% to $60.3 million in fiscal 1992. However, chemical sciences division director Robert S. Marianelli indicates the situation isn't quite so bad as it seems, though it's still not great. There is about $5.5 million available, enough to cover the cost of inflation for the division's research programs in fiscal 1992.

National Science Foundation. NSF acting director Frederick M. Bernthal started off his briefing on the agency's fiscal 1992 budget by remarking, "I must have the easiest job in the city of Washington today" in view of the "really extraordinary budget" that President Bush has submitted to Congress for NSF. And it is extraordinary. As Bernthal noted, if the 18% increase to $2.6 billion slated for NSF isn't the highest increase to any federal agency, it must be close.

Huge SSC increase skews DOE R&D funding

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991-92
ENERGY R&D	**$4135.0**	**$3847.3**	**$3492.8**	**7%**
General science and research	**1542.5**	**1144.9**	**1056.2**	**35**
High-energy physics	666.4	588.7	576.3	13
Superconducting Super Collider	533.7	242.9	192.7	119
Nuclear physics	342.4	313.3	287.2	9
Basic energy sciences[c]	**569.7**	**572.5[d]**	**450.8**	**0**
Materials sciences	257.1	274.9	196.2	−7
Chemical sciences	158.3	157.6	138.5	0
Other research	154.3	140.0	116.1	10
Nuclear	**398.0**	**305.0**	**334.9**	**30**
Fusion	**337.1**	**273.8**	**316.5**	**23**
Clean coal technology	**315.0**	**391.0**	**334.9**	**−20**
Biological, environmental	**312.6**	**368.6**	**305.2**	**−15**
Conservation	**274.1**	**214.6**	**158.8**	**28**
Fossil	**184.0**	**378.8**	**393.4**	**−51**
Solar and other renewables	**202.0**	**198.3**	**142.1**	**2**
DEFENSE R&D	**2565.0**	**2506.9**	**2550.6**	**2**
Weapons R&D, testing	1764.0	1737.1	1908.6	1
Naval reactor development	801.0	769.8	642.0	4
TOTAL	**$6700.0**	**$6354.2**	**$6043.4**	**5%**

Note: Budget authority. **a** Actual. **b** Estimate. **c** Operating expenses. **d** Includes $59.2 million for Congressionally directed projects for which no funding is requested in 1992. **Sources:** Department of Energy, Office of Management & Budget

NSF chemistry division director Kenneth G. Hancock is equally pleased with the 10%, $10 million increase to $112 million slated for the chemistry division. He notes that the requested 10% increase equals the total actual increase the division has gotten since 1987. And he says that after several years of putting much needed emphasis on infrastructure issues—undergraduates, graduates, postdocs—the emphasis in 1992, as it is to some extent this year, will be on individual investigator awards. That is where the increased funds will go. The increase, he says, will go not only to providing larger grants but also to improving the success rate for first-time applicants.

Hancock points to the new $50 million instrumentation initiative as being extremely important for chemistry. That initiative aims at providing researchers with access to equipment in the $100,000 to $2 million price range, equipment that is not currently funded out of regular research grants or under the research facilities modernization program, which is being done away with in the budget request anyway. To get one of the new instrumentation grants, cost-sharing of at least 50% from nonfederal sources will be required.

NSF is also not requesting any funding for a new round of science and technology centers in fiscal 1992. However, it is requesting what officials say is enough funding to keep the current S&T centers healthy. For example, the mathematical and physical sciences directorate is requesting a 12% increase to $21 million for the six S&T centers it supports.

Department of Agriculture. At USDA, Bush is proposing $1.3 billion in R&D funding for fiscal 1992, a slight decrease from the amount appropriated in 1991. The Agricultural Research Service, the largest research agency within USDA, would increase 7% to about $717 million. But the Cooperative State Research Service (CSRS) and the forest service research both face a cut.

A large part of the decline stems from the Administration's request for less money for two programs within CSRS. Those programs, buildings and facilities construction and so-called special research grants, in the past have received funds earmarked for pet projects of Representatives and Senators. In an effort to curtail such pork-barreling, the Administration has suggested a new program of competitive grants for renovation and construction of facilities for agricultural sciences. The proposed $25 million in grants would require matching funds from nonfederal sources.

The Competitive Research Grants Office within CSRS, which administers the only grants at USDA that are distributed through a competitive peer-review process, would receive a 71% increase from 1991 levels. Bush has asked for $125 million for the office's National Research Initiative, established last year, which seeks to apply advanced research tools to agricultural problems (C&EN, Nov. 26, 1990, page 15).

"This will be a pretty good increase as long as we don't have to spread it over too many new programs," says Paul Stumpf, the research grants office's chief scientist. Stumpf remains concerned, however, about a 14% cap on overhead imposed last year by Congress and about the possibility Congress may require matching funds on all competitive grants.

NSF's total budget is up 18% . . .

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991-92
Mathematical and physical sciences	$ 650.1	$ 558.3	$ 518.5	16%
Geosciences	419.5	367.7	325.0	14
Education and human resources	390.0	322.4	220.6	21
Biological, behavioral, and social sciences	355.6	315.4	293.7	13
Engineering	247.7	215.7	200.1	15
Computer and information science and engineering	229.5	186.1	169.8	23
Antarctic research	118.0	100.4	71.8	17
Salaries and expenses	122.0	101.0	96.3	21
Scientific, technological, and international affairs	61.0	51.0	47.8	20
Research instrumentation	50.0	0	0	
Research facilities modernization	0	20.5	0.4	−100
TOTAL	$2643.4	$2238.5	$1944.0	18%

. . . with funding for the sciences up 12% . . .

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991-92
Ocean sciences	$ 188.5	$ 164.8	$ 147.3	14%
Physics	142.0	129.0	123.8	10
Atmospheric sciences	132.8	114.5	104.1	16
Materials research	136.6	122.6	117.0	11
Chemistry	112.0	102.1	97.9	10
Astronomical sciences	107.4	97.3	91.5	10
Mathematical sciences	79.5	72.0	69.3	10
Biotic systems, resources	78.3	70.7	66.5	11
Earth sciences	74.7	68.3	60.1	9
Cellular biosciences	67.9	61.0	57.7	11
Molecular biosciences	57.5	51.3	48.2	12
Behavioral, neural sciences	51.6	47.8	45.8	8
Social, economic sciences	41.3	35.0	32.3	18
TOTAL	$1270.1	$1136.4	$1061.5	12%

. . . and for chemical programs up 11%

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991-92
Materials research	$136.6	$122.5	$117.0	11%
Project support	80.2	69.6	66.2	15
Laboratories and groups	37.8	35.8	34.6	6
Facilities, instrumentation	18.6	17.1	16.2	9
Chemistry	111.9	102.1	97.8	10
Physical	33.0	30.1	29.0	10
Organic and macromolecular	27.7	25.3	24.5	9
Inorganic, bioinorganic, and organometallic	19.6	17.3	16.2	13
Analytical and surface	15.4	13.7	12.9	12
Instrumentation	8.1	8.1	8.1	0
Special projects	8.1	7.6	7.1	7
Chemical and thermal systems engineering	38.2	33.0	30.8	16
Interfacial, transport, and separations process	9.9	8.7	7.5	14
Fluid, particulate, and hydraulic systems	9.8	9.2	9.0	6
Chemical reaction processes	9.4	7.0	6.9	34
Thermal systems	9.1	8.1	7.4	12
Biochemistry	16.1	14.6	14.3	10
Cellular biochemistry	14.9	13.1	12.3	14
TOTAL	$317.7	$285.3	$272.2	11%

Note: Obligations. a Estimate. b Actual. **Source:** National Science Foundation

No growth in overall USDA research funds

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
Agricultural Research Service	$ 716.7	$ 672.5	$ 606.1	7%
Cooperative State Research Service	409.2	454.2	385.6	–10
Forest service research	166.8	186.0	156.1	–10
National Agricultural Library	17.5	16.8	14.7	4
TOTAL	$1310.2	$1329.5	$1162.5	–1%

Note: Obligations. a Estimate. b Actual. Source: Department of Agriculture

Clean Air Act boosts research at EPA

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
Multimedia	150.7	124.2	84.0	21%
Air	112.4	86.6	77.9	30
Superfund	68.6	73.6	78.7	–7
Hazardous waste	43.6	39.2	43.9	11
Water quality	28.9	27.7	26.9	4
Toxic substances	26.3	25.5	27.2	3
Drinking water	22.2	20.7	20.9	7
Pesticides	15.0	12.6	12.7	19
Energy/acid rain	13.7	13.6	33.3	0
Management & support	5.3	5.2	14.7	0
Radiation	4.0	4.0	3.6	0
Leaking underground storage tanks	0.8	0.8	0.7	0
TOTAL	$491.5	$433.7	$424.5	13%

Note: Obligations. a Estimate. b Actual. Source: Environmental Protection Agency

Chemical sciences rise moderately at NIST

$ Millions	1992[a]	1991[a]	1990[b]	% change 1991–92
SCIENTIFIC & TECHNICAL SERVICES				
Research support activities	$ 37.8	$ 29.6	$ 24.3	28%
Electronics & electrical	33.6	21.3	16.2	58
Materials science	28.7	26.5	23.2	8
Physics	26.5	25.5	24.8	4
Chemical sciences	20.8	18.6	16.9	12
Computer sciences	15.0	11.8	9.4	27
Manufacturing engineering	12.6	8.3	6.2	53
Building & fire research	10.6	9.8	11.3	8
Technology assistance	10.1	9.0	7.4	12
Applied mathematics	6.1	5.8	5.6	4
INDUSTRIAL TECHNOLOGY SERVICES				
Advanced technology program	35.9	35.9	9.9	0
Manufacturing centers	10.3	11.9	7.4	–13
State technology program	0	1.3	1.3	–100
TOTAL	$248.0	$215.3	$163.8	15%

Note: Obligations. a Estimate. b Actual. Source: National Institute of Standards & Technology

Environmental Protection Agency. The agency's Science Advisory Board last year strongly recommended that EPA's R&D budget be doubled over the next five years so that the nation's environmental policy decisions could be made on a sound scientific basis. This year's proposal is at least a decent start at that goal, increasing by more than 13% to nearly $492 million. Almost all the increase has been in two areas.

Passage of the 1990 Clean Air Act added considerable responsibilities to EPA research. The agency says the 1992 proposed budget would provide $20.5 million just to conduct research necessary to implement the law's requirements. Some of these activities include studying ozone levels on nonattainment metropolitan areas, air pollution from mobile sources, health concerns from air toxics, and acid deposition.

The second area of significant increase is multimedia research. With a proposed increase of $26.5 million for fiscal 1992, it is the fastest growing part of EPA's program. Its growth comes from recognizing that little is understood about how complex ecological systems are affected by pollution over time. Among other items, the multimedia program provides more work on lead toxicity studies and pollution prevention research. EPA's Environmental Monitoring & Assessment Program would benefit from the increases as well, expanding its research on large regional ecosystems such as the Gulf of Mexico, Chesapeake Bay, and the Great Lakes.

National Institute of Standards & Technology. This office of the Commerce Department continues to grow very strongly. After a greater than 30% increase in fiscal 1991, NIST has a proposed budget of $248 million for 1992, a 15% increase. All of the increase would be applied to in-house work at NIST, a budget increase of 21%. Extramural programs have been cut or eliminated. The state technology program would be eliminated in the proposed budget, and funding for the Manufacturing Technology Centers cut 13% to $10.3 million.

The NIST program is to expand its ability to support U.S. industry in economically important areas such as electronics, advanced materials, computers, communications, industrial chemical technology, and manufacturing. In 1992, $22 million for new initiatives at NIST would go toward measurement technology and standards for high-temperature superconductors, intelligent machines, and fiber-optic communications systems; new security criteria for computer and telecommunications systems; and thermophysical property data needed for alternatives to chlorofluorocarbon refrigerants.

In the chemical sciences program, NIST plans a 12% increase to $20.8 million, a mild increase compared with others. Much of the focus here will be to continue to supply high-technology industries with the new measurement methods they need to produce products to an ever higher degree of specification. These include on-line optical and electrochemical sensors to reduce defective products. Other programs include, in part, measurement methods for DNA profiling and separation of biomolecules, computerized expert systems for automated control of chemical analysis systems, and ultra-thin film sensors for manufacturing control. □

Fourth-Quarter Drop Contributes to Lower 1990 Chemical Earnings

William J. Storck,

C&EN Northeast News Bureau

Higher feedstock costs brought on by the crisis in the Middle East and a continued soft economy cut sharply into chemical companies' earnings in the fourth quarter.

The result was a continuation of the decline for both chemical companies and diversified firms that produce chemicals. However, total fourth-quarter earnings increased from year-earlier levels for oil- and gas-producing firms and at pharmaceutical companies, although chemical results cut into the bottom line at the oil producers.

Earnings for 29 of the 30 major chemical companies regularly surveyed by C&EN dropped an average of 19% to a combined $1.01 billion, marking the sixth straight quarter of earnings declines. However, this most recent decline is the first since fourth-quarter 1989 that the decrease was not more than 20%.

Sales, however, were helped greatly by increased selling prices. Combined sales for the 29 companies rose 13% to $21.9 billion. The result of the disparity between the increase in sales and the decline in earnings was that profitablity at the companies fell rapidly. Profit margins in the fourth quarter of 1990 for the companies averaged 4.6%, compared with 6.4% in the year-earlier quarter. This is the lowest quarterly profitability level since the final three months of 1986.

However, while the drop in earnings was less than in any quarter in 1990, it was more widespread among the chemical companies surveyed. A total of 16 out of the 29 companies reported decreases in earnings in the fourth quarter, com-

Chemical industry leaders for the fourth quarter . . .

Sales

Rank 1990		$ Millions	Rank 1989
1	Dow Chemical	$5147.0	1
2	Monsanto	2202.0	2
3	W. R. Grace	1946.5	4
4	Union Carbide	1875.0	3
5	American Cyanamid	1133.1	5
6	Hercules	820.7	6
7	Quantum Chemical	765.4	9
8	Arco Chemical	759.0	11
9	Air Products	724.6	7
10	Rohm & Haas	677.7	10

Earnings[a]

	$ Millions	Rank 1989
Dow Chemical	$274.0	1
W. R. Grace	73.8	3
Arco Chemical	68.0	4
Air Products	60.6	8
Ethyl	58.0	5
American Cyanamid	56.5	7
Union Carbide	52.0	2
Rohm & Haas	36.8	16
Great Lakes Chemical	36.6	12
Nalco Chemical	35.6	11

Profitability

	Earnings as % of sales	Rank 1989
International Flavors	13.2%	3
Great Lakes Chemical	12.6	2
Loctite	11.4	6
Nalco Chemical	10.9	5
Betz Laboratories	10.5	7
Arco Chemical	9.0	4
Ethyl	8.6	9
Air Products	8.4	12
Georgia Gulf	8.3	1
Crompton & Knowles	7.2	13

. . . and for full-year 1990

Sales

Rank 1990		$ Millions	Rank 1989
1	Dow Chemical	$19,773.0	1
2	Monsanto	8,995.0	2
3	Union Carbide	7,621.0	3
4	W. R. Grace	6,754.0	4
5	American Cyanamid	4,570.2	5
6	Hercules	3,200.0	6
7	Air Products	3,146.8	10
8	Arco Chemical	2,830.0	8
9	Rohm & Haas	2,824.2	9
10	Quantum Chemical	2,656.1	7

Earnings[a]

	$ Millions	Rank 1989
Dow Chemical	$1384.0	1
Monsanto	490.0	2
Arco Chemical	394.0	4
Union Carbide	353.0	3
American Cyanamid	314.0	5
Air Products	234.8	7
Ethyl	223.8	6
Rohm & Haas	206.8	10
W. R. Grace	202.8	8
International Flavors	156.7	12

Profitability

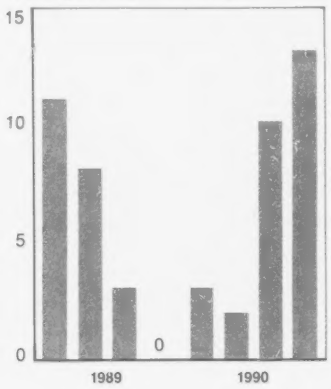
	Earnings as % of sales	Rank 1989
International Flavors	16.3%	2
Arco Chemical	13.9	4
Great Lakes Chemical	13.2	3
Loctite	12.1	7
Betz Laboratories	11.0	9
Nalco Chemical	10.8	8
Georgia Gulf	10.2	1
Ethyl	8.9	10
Crompton & Knowles	7.7	17
Air Products	7.5	13

Note: Based on 30 chemical companies listed on page 20. a After taxes.

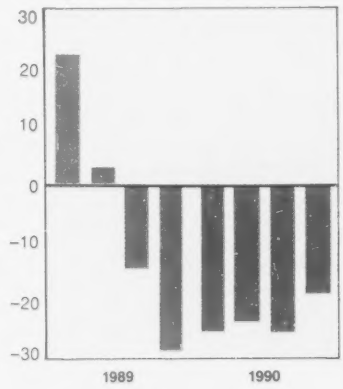
Chemical industry 1990 fourth-quarter results

- Sales increased 13%
- Earnings dropped 19%
- Profit margins fell to 4.6%
- Production hardly rose
- Prices jumped 5%

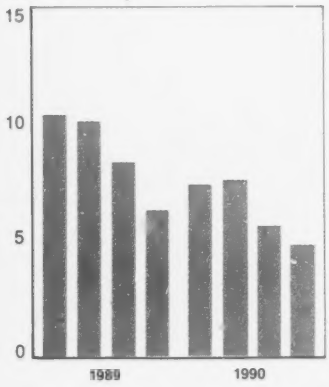
Sales
% change from year-earlier quarter



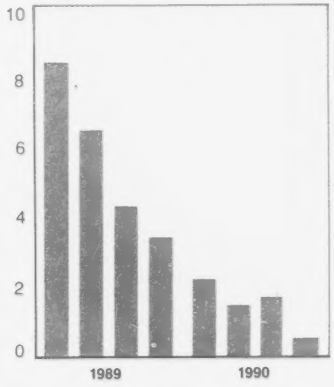
Earnings
% change from year-earlier quarter



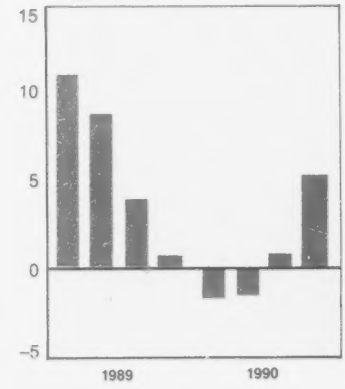
Profit margins
After-tax earnings as % of sales



Production
% change from year-earlier quarter

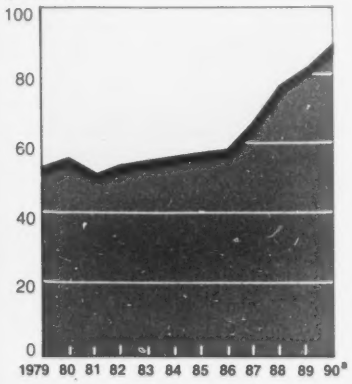


Prices
% change from year-earlier quarter

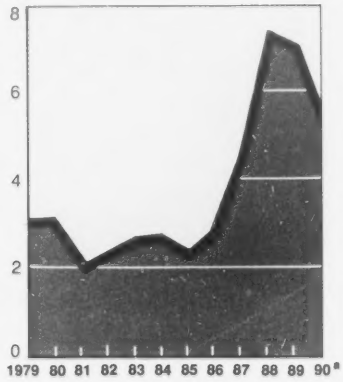


Sales in 1990 rose about 7% but earnings declined 23%, lowering profit margins to about 6.3%

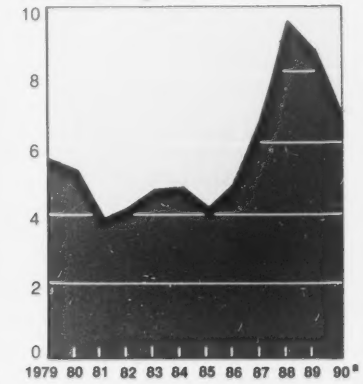
Annual sales
$ Billions



Annual earnings
$ Billions



Annual profit margins
After-tax earnings as % of sales



Note: All sales, earnings, and profit data are based on 30 chemical companies listed on page 20. a C&EN estimates.

Fourth-quarter earnings fell average of 19% for major chemical companies

	FOURTH-QUARTER 1990						FULL-YEAR 1990					
	Sales	Earnings[a]	Change from 1989		Profit margin[b]		Sales	Earnings[a]	Change from 1989		Profit margin[b]	
	($ millions)		Sales	Earnings	1990	1989	($ millions)		Sales	Earnings	1990	1989
Air Products	$ 724.6	$ 60.6	11%	23%	8.4%	7.6%	$ 3,146.8	$ 234.8	19%	14%	7.5%	7.7%
American Cyanamid	1,133.1	56.5	21	11	5.0	5.4	4,570.2	314.0	8	13	6.9	6.6
Arco Chemical	759.0	68.0	25	–9	9.0	12.4	2,830.0	394.0	6	–3	13.9	15.2
Betz Laboratories	152.4	16.0	19	19	10.5	10.5	596.8	65.5	16	17	11.0	10.8
Cabot	448.3	19.3	10	5	4.3	4.5	1,715.3	60.7	–8	21	3.5	2.7
Chemed	149.0	1.9	2	–66	1.3	3.9	599.4	16.6	1	–37	2.8	4.4
Crompton & Knowles	101.0	7.3	19	21	7.2	7.1	390.0	30.0	10	22	7.7	6.9
Dow Chemical	5,147.0	274.0	21	–36	5.3	10.0	19,773.0	1384.0	12	–44	7.0	14.1
Ethyl	676.5	58.0	5	–7	8.6	9.7	2,510.0	223.8	3	2	8.9	9.0
First Mississippi	118.4	–1.4	–10	def	def	1.0	516.8	5.0	4	–39	1.0	1.6
H. B. Fuller	203.0	8.1	7	60	4.0	2.7	792.2	21.1	5	35	2.7	2.1
Georgia Gulf	229.0	19.1	–6	–54	8.3	17.0	932.1	95.3	–16	–50	10.2	17.4
B. F. Goodrich	575.8	14.1	0	–50	2.4	4.9	2,432.6	115.8	1	–32	4.8	7.1
W. R. Grace	1,946.5	73.8	13	–12	3.8	4.8	6,754.0	202.8	10	4	3.0	3.2
Great Lakes Chemical	289.4	36.6	28	16	12.6	13.9	1,066.3	140.8	35	15	13.2	15.5
Hercules	820.7	24.5	6	def	3.0	def	3,200.0	128.1	3	24	4.0	3.3
Imcera	396.2	20.9	18	113	5.3	2.9	1,528.4	85.4	30	2	5.6	7.1
International Flavor	219.3	28.8	16	18	13.2	12.9	962.8	156.7	11	13	16.3	15.9
Loctite	143.2	16.4	18	21	11.4	11.1	555.2	67.4	17	16	12.1	12.3
Lubrizol	na	na	na	na	na	5.7	na	na	na	na	na	7.7
Monsanto	2,202.0	11.0	10	–80	0.5	2.7	8,995.0	490.0	4	–23	5.4	7.3
Morton International	470.8	30.1	15	–10	6.4	8.2	1,798.9	133.4	20	14	7.4	7.8
Nalco Chemical	325.5	35.6	15	9	10.9	11.5	1,212.3	131.1	13	9	10.8	11.2
Olin	640.0	8.0	7	–74	1.3	5.2	2,592.0	84.0	3	–32	3.2	4.9
Petrolite	82.1	3.1	9	–11	3.8	4.7	300.3	13.1	3	8	4.4	4.2
Quantum Chemical	765.4	9.7	22	–46	1.3	2.9	2,656.1	21.2	–1	–81	0.8	4.3
Rohm & Haas	677.7	36.8	9	72	5.4	3.4	2,824.2	206.8	6	17	7.3	6.6
Union Carbide	1,875.0	52.0	4	–50	2.8	5.7	7,621.0	353.0	0	–44	4.6	8.2
Vista Chemical	176.3	6.3	4	–55	3.6	8.3	725.1	50.8	–4	–51	7.0	13.6
Witco	413.7	10.6	9	–26	2.6	3.8	1,631.5	68.0	3	–13	4.2	4.9
TOTAL[c]	$21,860.9	$1005.6	13%	–19%	4.6%	6.4%	$85,228.4	$5293.3	7%	–24%	6.2%	8.7%

a After-tax earnings from continuing operations, excluding significant extraordinary and nonrecurring charges. b After-tax earnings as a percentage of sales. c For 29 companies reporting. def = deficit. na = not available.

pared with 12 companies that reported declines in both the second and third quarters in 1990.

On a quarter-to-quarter basis, combined earnings for the 29 companies in the fourth quarter dropped 12% from the previous quarter. Sales, however, rose about 2% in the same period.

Earnings declines for the first three quarters of 1990 averaged 25%. So although the fourth-quarter's 19% decline may represent a slight moderation, it didn't do much to improve the full-year earnings result. The final tally shows that 1990 earnings fell 24% from 1989 to a combined $5.29 billion. Sales for the year increased 7% to a total of $85.2 billion.

Thus, average profit margins for the year for the group of chemical companies was 6.2%, still relatively high by historical standards but down from 8.7% in the previous year. This is the lowest measure of return on sales in four years. Twelve of the companies surveyed showed earnings declines for the year.

One of the main reasons for the increased sales dollar volumes in the fourth quarter was that chemical producers were able to pass along price increases on many of their products. Although chemical prices in the third quarter were up only 1% from the same period in 1989, according to government figures, in the fourth quarter they increased 5.2% from a year earlier. And they were up 3.4% from the previous three months of last year. However, output from chemical plants did not provide much help. Government data show that fourth-quarter production of chemicals and allied products was up less than 1% from fourth-quarter 1989. And fourth-quarter production was down more than 1% from the previous quarter.

The disparity between the increased prices and increased costs was made plain by Dow Chemical, whose fourth-quarter earnings fell

Fourth-quarter earnings increased for oil and drug firms, but fell for diversified companies

	FOURTH-QUARTER 1990						FULL-YEAR 1990					
	Sales	Earnings[a]	Change from 1989		Profit margin[b]		Sales	Earnings[a]	Change from 1989		Profit margin[b]	
	($ millions)		Sales	Earnings	1990	1989	($ millions)		Sales	Earnings	1990	1989
OIL AND GAS COMPANIES												
American Petrofina	$ 1,194.7	$ 19.1	58%	41%	1.6%	1.8%	$ 3,978.2	$ 125.5	31%	5%	3.2%	3.9%
Amoco	9,187.0	538.0	35	69	5.9	4.7	31,592.0	1,913.0	18	19	6.1	6.0
Chevron	13,800.0	801.0	55	150	5.8	3.6	42,600.0	2,181.0	30	50	5.1	4.4
Exxon	35,261.0	1555.0	32	21	4.4	4.8	117,079.0	5,010.0	22	8	4.3	4.8
Kerr-McGee	1,116.0	50.3	44	26	4.5	5.2	3,682.6	150.3	23	12	4.1	4.5
Mobil	19,147.0	651.0	30	46	3.4	3.0	64,244.0	1,928.0	14	7	3.0	3.2
Occidental Petroleum	6,063.0	68.0	20	127	1.1	0.6	21,694.0	358.0	8	40	1.7	1.3
Phillips Petroleum	4,322.0	294.0	42	1076	6.8	0.8	13,603.0	688.0	10	38	5.1	4.0
Shell Oil	7,657.0	446.0	39	69	5.8	4.8	24,790.0	1,036.0	13	-26	4.2	6.4
Sun Co.	4,030.0	18.0	31	350	0.4	0.1	13,380.0	229.0	18	-17	1.7	2.4
Texaco	12,991.0	473.0	41	69	3.6	3.0	41,822.0	1,535.0	17	26	3.7	3.4
Unocal	3,379.0	118.0	19	168	3.5	1.5	11,808.0	349.0	4	4	3.0	3.0
TOTAL	**$118,147.7**	**$5031.4**	**35%**	**64%**	**4.3%**	**3.5%**	**$390,272.8**	**$15,502.8**	**18%**	**13%**	**4.0%**	**4.2%**
DIVERSIFIED MANUFACTURERS												
Allied-Signal	3,143.0	107.0	3	-7	3.4	3.8	12,343.0	462.0	3	-9	3.7	4.2
Du Pont	11,064.0	468.0	23	-3	4.2	5.4	40,047.0	2,310.0	13	-7	5.8	7.0
Eastman Kodak	5,151.0	326.0	5	24	6.3	5.4	18,900.0	1,270.0	3	18	6.7	5.9
Engelhard	657.8	21.4	5	48	3.3	2.3	2,942.2	70.3	22	14	2.4	2.6
FMC	980.5	27.1	19	-16	2.8	3.9	3,722.2	155.3	9	-1	4.2	4.6
Ferro Corp.	281.7	6.2	4	-50	2.2	4.6	1,124.8	27.3	4	-45	2.4	4.6
3M	3,280.0	295.0	11	1	9.0	9.9	13,021.0	1,308.0	9	5	10.0	10.4
NL Industries	227.3	10.5	5	-49	4.6	9.5	906.6	93.5	-9	-45	10.3	17.0
PPG Industries	1,500.0	101.4	5	0	6.8	7.1	6,021.0	474.8	5	2	7.9	8.1
Tenneco	3,881.0	130.0	0	-37	3.3	5.3	14,511.0	561.0	3	-4	3.9	4.1
Vulcan Materials	271.0	19.8	5	-16	7.3	9.2	1,105.3	120.3	3	-10	10.9	12.4
TOTAL	**$ 30,437.3**	**$1512.4**	**11%**	**-3%**	**5.0%**	**5.7%**	**$114,644.1**	**$ 6,852.5**	**7%**	**-1%**	**6.0%**	**6.5%**
PHARMACEUTICAL COMPANIES												
Abbott Laboratories	1,710.1	279.8	17	11	16.4	17.4	6,158.7	965.8	14	12	15.7	16.0
American Home Products	1,613.2	328.2	-2	8	20.3	18.6	6,775.2	1,230.6	0	20	18.2	15.3
Baxter International	2,174.0	178.0	11	28	8.2	7.1	8,100.0	40.0[c]	9	-91	0.5	6.0
Bristol-Myers Squibb	2,735.9	425.5	16	25	15.6	14.4	10,299.7	1,747.7	12	21	17.0	15.7
Merck	2,099.3	442.2	19	20	21.1	20.9	7,671.5	1,781.2	17	19	23.2	22.8
Pfizer	1,785.3	154.8	19	78	8.7	5.8	6,406.0	801.2	13	18	12.5	12.0
Shering-Plough	800.0	130.6	3	18	16.3	14.3	3,322.9	565.1	5	20	17.0	14.9
Upjohn	798.7	115.9	18	29	14.5	13.3	3,020.9	458.1	11	16	15.2	14.5
Warner Lambert	1,245.5	105.4	19	14	8.5	8.8	4,686.9	484.9	12	18	10.3	9.8
TOTAL	**$ 14,962.0**	**$2160.3**	**14%**	**21%**	**14.4%**	**13.5%**	**$ 56,441.8**	**$ 8,074.6**	**11%**	**12%**	**14.3%**	**14.2%**

a After-tax earnings from operations excluding significant extraordinary and nonrecurring items. b After-tax earnings as a percentage of sales. c Includes significant nonrecurring charge.

36% to $274 million on a 21% increase in sales to almost $5.15 billion. Frank P. Popoff, president and chief executive officer, says: "Fourth-quarter results, although lower, were not surprising, given economic weakness and soaring energy and feedstock costs that could not be fully recovered by higher prices."

Dow points out that prices increased 5% from the previous quarter, but this only partially recovered the rising energy and feedstock costs, which climbed 37%. The company also says that physical volume and operating rates were essentially flat compared with the previous three months.

Union Carbide, whose fourth-quarter earnings were off 50%, was another company caught in the vise of rising feedstock costs. Company chairman Robert D. Kennedy says that fourth-quarter operating results "continued to reflect very competitive market conditions in a softening U.S. economy, as well as higher feedstock costs during the quarter, resulting from conditions in the Middle East."

Petrochemical earnings slide in fourth quarter

Chemical earnings at major oil companies were buffeted in the fourth quarter. These operations, which are made up largely of commodity petrochemicals, produced an earnings decline of 42% for the eight companies that split out net earnings of their chemical units.

The decline, to an aggregate $388 million, would have been much worse, save for a recovery in chemical operations at Unocal.

Most of the companies that reported earnings of their chemical operations had the same complaints about business in the fourth quarter. These included primarily higher feedstock costs leading to lower profitability. In many cases, however, these higher costs for raw materials were partly offset by increased prices and higher sales volumes, according to statements from the companies.

EARNINGS ON CHEMICAL OPERATIONS

$ Millions	Fourth quarter 1990	Fourth quarter 1989	% change	Full year 1990	Full year 1989	% change
Amoco	$ 3.0	$ 79.0	-96%	$ 171.0	$ 481.0	-64%
Chevron	41.0	61.0	-33	203.0	378.0	-46
Exxon	98.0	138.0	-29	518.0	1082.0	-52
Mobil	64.0	79.0	-19	323.0	558.0	-42
Occidental Petroleum	126.0	214.0	-41	636.0	1056.0	-40
Shell Oil	55.0	84.0	-35	308.0	630.0	-51
Texaco	-10.0	15.0	def	48.0	268.0	-82
Unocal	11.0	2.0	450	41.0	49.0	-16
TOTAL	$388.0	$672.0	-42%	$2248.0	$4502.0	-50%

def = deficit.

In spite of the large decline in the quarter, only one firm registered a loss—Texaco, which went into the red by $10 million, compared with earnings of $15 million in the same period in 1989. It is interesting that all of Texaco's loss came within the U.S. Foreign chemical businesses at the company earned $3 million in the fourth quarter, the same as fourth-quarter 1989.

The fourth quarter, although down in terms of earnings, was still a little better for the oil companies than their cumulative results for the full year, when earnings from chemical operations were essentially cut in half to a total of about $2.25 billion.

Monsanto's chemicals business also felt the impact of sharply higher costs for petroleum-based raw materials. But chairman Richard J. Mahoney says he expects petrochemical prices to fall back to levels that reflect supply-demand fundamentals once the Middle East conflict is resolved.

Not all was gloom in the fourth quarter, however. Air Products & Chemicals, for instance, increased its earnings 23% to $60.6 million on an 11% sales rise to $725 million. Chairman Dexter F. Baker says the higher results in the quarter "reflect good performance in each of our business segments, particularly chemicals."

Earnings at Imcera more than doubled to $20.9 million. Chairman George D. Kennedy credited new products, capacity additions, and improved operating performance.

For the coming year, chemical executives see better times. For instance, Monsanto's Mahoney told an analysts meeting in New York City earlier this month that the company's agricultural unit is expected to rebound this year, and although the chemical unit will still be affected by a weak U.S. economy, the strategy that moved it out of commodity petrochemicals into higher value-added products will make it less vulnerable than commodity producers.

And at Air Products, Baker says, "While there is a great deal of uncertainty in the global economic outlook, we continue to expect Air Products' sales and earnings in 1991 will exceed those of 1990." □

Chemicals have role in China's economic plans

China has just issued its new five- and 10-year economic development plans. The chemical industry plays a key role, although it may have trouble finding enough investment capital to carry it out.

In a recent report in *China Daily*, Gu Xiulian, minister of the chemical industry, is quoted telling industry and government officials that the Chinese chemical industry will be concentrating on three major areas of production and development—namely, agricultural chemicals, petrochemicals, and "precision chemicals." She noted that "even though the [chemical] industry is weak in the national economy," it will invest large amounts of capital in new production facilities.

The problem of feeding nearly 1.2 billion people remains China's biggest challenge. Thus, the highest priority for the chemical industry remains fertilizers and agricultural chemicals such as pesticides. This may cause some problems in the future because this sector of the industry traditionally generates only modest profits.

In the next 10 years, Gu says, China's chemical industry will invest in a large number of fertilizer plants. These will include eight large nitrogenous plants in Sichuan, Liaoning, Jilin, and Jiangsu provinces, and in Inner Mongolia. Six large compound-fertilizer plants also will be built together with five phosphate plants that produce by-product sulfur.

By the end of the century, China also will push construction of large petrochemical projects in Jilin, Beijing, and in the Xinjiang Uygar Autonomous Zone. Coal chemical plants are scheduled to be built in Shandong and Shaanxi provinces.

The field of greatest potential profits is "precision chemicals," meaning high-tech polymers, industrial plastics, special chemicals, and products for the textile, rubber, and auto industries.

Joseph Haggin

Rising Pollution Control Costs May Alter EPA's Regulatory Direction

EPA study predicts a surprising shift to expenditures to control land pollution, and agency administrator stresses pollution prevention strategy

Lois R. Ember, C&EN Washington

The U.S. currently spends $115 billion a year, or 2.1% of its gross national product, on pollution control. By the year 2000 the cost of such protection could rise to as high as $185 billion a year (in 1990 dollars), or 2.8% of GNP, the Environmental Protection Agency estimates.

These findings are in "Environmental Investments: The Cost of A Clean Environment," a report EPA Administrator William K. Reilly sent to Congress on Feb. 1. More than two years in the making, the "cost-of-clean" report was mandated by the Clean Air Act and by the Clean Water Act, but it is likely to strongly influence the direction the agency takes in the next few years.

Concerned about the rising costs of pollution control, Reilly says the agency must "find and apply more cost-effective approaches, ... engage in negotiations and voluntary agreements to cut pollution, ... foster breakthroughs in cleanup technologies, and ... explore new ways to finance environmental improvements."

Recently the EPA Science Advisory Board has said that federal laws and programs "are more reflective of public perceptions of risk than of scientific understanding of risk." Reilly has taken this scientific sentiment to heart. And along with the just-released report, he plans to use the SAB finding as fodder for his effort to redirect agency "resources, where discretion is allowed, to the highest priority environmental risks."

One of the most surprising findings of the report is an expected shift over the next decade from expenditures to control air and water pollution to those to control land pollution. SAB, however, has concluded that pollution on land poses fewer risks than air- and water-related pollution.

Although total pollution control costs are increasing, they are doing so at a decreasing rate. The yearly rate of increase was 14% between 1972 and 1973, 6 to 8% in the mid-1980s, and is likely to fall to about 3% in the late 1990s. Despite the increases, total pollution control costs are less than half those for clothing and shoes, one third those for national defense or medical care, one fifth those for housing, and one sixth those for food.

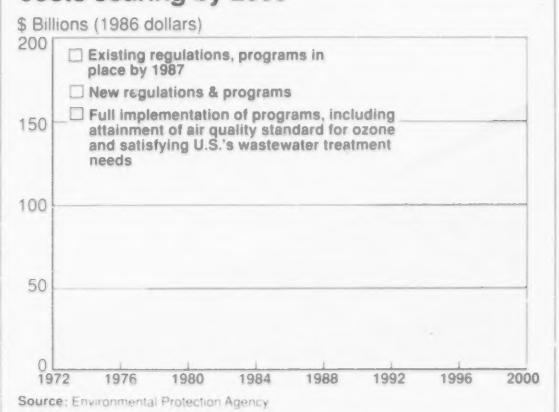
From 1980 through 1987 total costs allocated by funding source were rather stable. But from 1987 to 2000 EPA and its contractor for the cost-of-clean study, the Environmental Law Institute, project rapid growth in the federal share with corresponding cuts in all other shares, especially the private sector. The prime reason for this is the projected 140% increase in spending by the departments of Defense and of Energy to clean up military and nuclear waste.

And even though the local share percentage is expected to drop slightly in the next decade, real pollution control burdens are likely to increase for municipalities. In turn these burdens are expected to be passed along to consumers as they are increasingly asked to pay higher fees for locally provided services.

The report finds that U.S. pollution control costs as a percentage of gross domestic product appears to be higher than in several Western European countries. For example, in 1985, the latest date for which comparable data exist, the U.S. spent 1.67% of its GDP on pollution control. The comparable figure for the former West Germany is 1.52%, the U.K. 1.25%, France 1.10%, and Norway 0.82%.

According to the report's author, Alan P. Carlin, an economist in EPA's Office of Policy, Planning & Evaluation, the report has not yet been reviewed by SAB or by anybody outside the federal government. It has been circulated to other environmental and statistical agencies within the government, especially the Department of Commerce, which supplied the histor-

Fully implemented regulations could send costs soaring by 2000



Source: Environmental Protection Agency

ical data used to make the straight-line extrapolations to the year 2000. And, of course, it had to be reviewed and approved by the Office of Management & Budget before Reilly could send it to Congress.

Governmental officials who have read the report believe it is about the best that can be obtained given the constraints—statistical and organizational. One official says the EPA study "is likely to be very much quoted and no one is likely to come up with a set of estimates that will bring EPA's into doubt."

Carlin notes that Reilly "refers to the report in almost every recent speech he has given. It appears to play a prominent role in what he's thinking and where he wants to lead the agency."

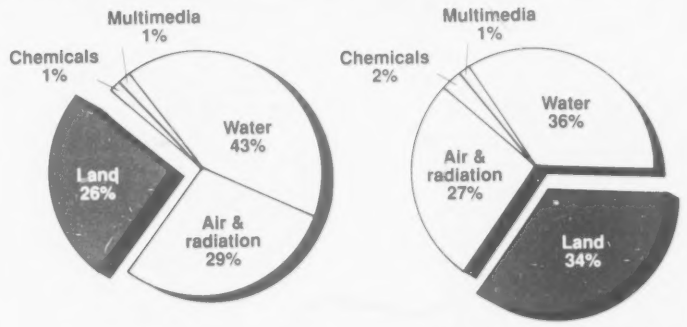
Clearly Reilly wants to steer his agency to what he calls "economically smart approaches to environmental protection." High on his strategic planning agenda is pollution prevention. And a subset of this is voluntary pollution reductions. Most recently Reilly called on more than 600 U.S. companies to voluntarily cut emissions of 17 so-called high-priority toxic chemicals.

Reilly's goal is to reduce total releases and transfers of these targeted toxic chemicals by one third by 1992, and to cut them by one half by 1995. The 17 chemicals are taken from the Toxic Release Inventory. Each year the inventory reports on more than 300 toxic chemicals routinely released into the environment by some 20,000 industrial facilities.

Among the 600 companies being asked to voluntarily cut these emissions are some of the largest in the U.S. chemical industry. But other industrial sectors are also found on the list because the chemicals are used in metalworking or plating, machinery degreasing, petroleum refining, electrical and transportation equipment, pulp and paper products, furniture and instruments, as well as in the making of chemicals.

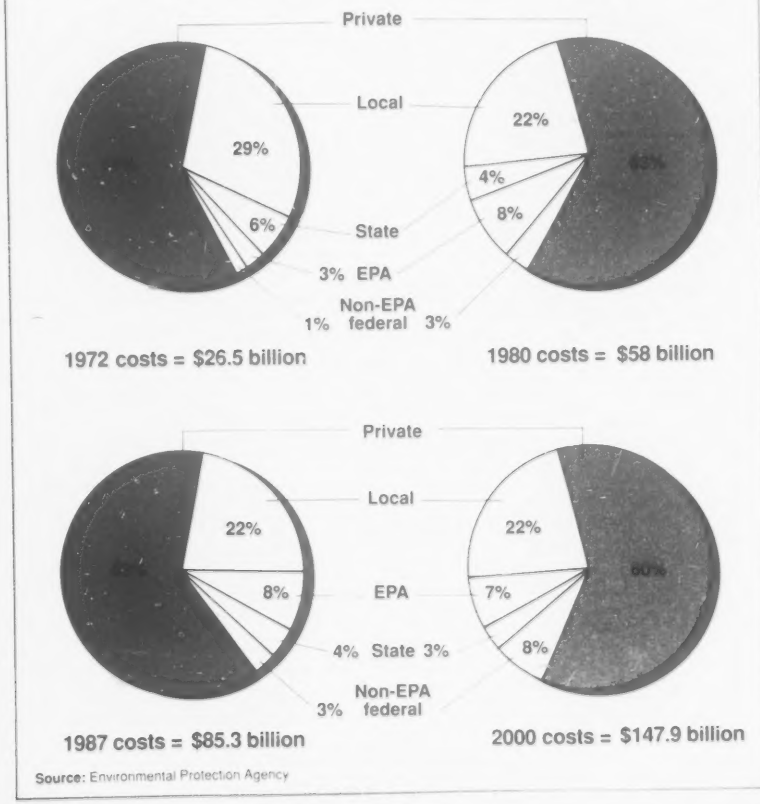
The 17 toxic chemicals have been chosen for a number of reasons—serious known health and environmental effects, a high potential for exposure, production volume, a high volume of releases, and recognized potential for cutting emissions. The chemicals targeted in EPA's Industrial Toxics Project are benzene, cadmium and its compounds, carbon tetrachloride, chloroform, chromium and its compounds, cyanide compounds, dichloromethane, lead and its compounds, mercury and its compounds, methyl ethyl ketone, methyl isobutyl ketone, nickel and its compounds, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, and xylenes. EPA has also targeted dioxins in its pollution prevention strategy, but they are being handled in a separate process. □

Total costs to control land pollution expected to rise



a Assuming full implementation of programs, including attainment of air quality standard for ozone and satisfying U.S.'s wastewater treatment needs (1986 dollars). **Source:** Environmental Protection Agency

Private sector's share of annual costs hovers around 60%



Source: Environmental Protection Agency